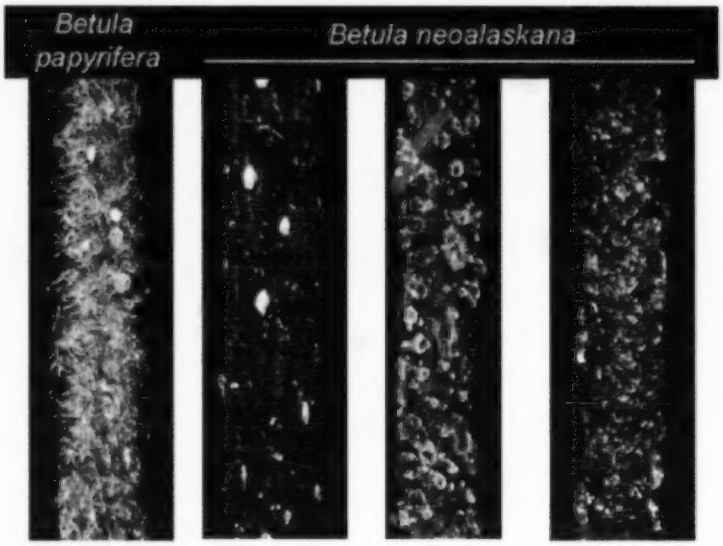
Column 438

Birch not defenceless in the boreal forest

by Sarah Locke

The ten-year cycle of snowshoe hares is one of the great mysteries of the boreal forest. While every northern biologist knows that hare numbers peak every decade or so, no one knows exactly why.

On-going research on snowshoe hares and birch in the boreal forest indicates that fire is yet another factor in the complex equation of this cycle. Hare numbers do not always peak at the same levels, and new research is showing that hare densities are higher in areas where larger areas of forest have burned.



Alaska paper birch (*Betula neoalaskana*) growing in burn areas produce more resin glands which defend the plants from browsing. (photo: John Bryant)

Forest fires are good for hares; they produce fresh growths of birch and willow shrubs, providing more food for hares. But many shrubs and small trees defend themselves against these onslaughts of hungry hares, and this ability could have started evolving during the last ice age.

In areas of heavy browsing, species like paper birch produce large quantities of gooey resin glands which contain papyriferic acid. This chemical discourages hares from browsing the twigs; if they munch anyway, they pass more sodium in their urine, and their overall health suffers.

But birches do not produce standard quantities of this acid, and young birch growing in burn areas in northern North American have the strongest chemical armour.

Suzanne Carrière, a biologist with the NWT government, became part of a widespread network of biologists looking at this phenomenon several years ago. She is studying regrowth after forest fires, and received a simple request from another biologist, John Bryant, for a few birch twigs.

Bryant has done pioneering work on snowshoe hare populations, and Carrière was a bit surprised when he seemed particularly excited about the clump of twigs that she

had sent him. Wanting to know exactly where she had collected them, he said that they were "the most defended twigs that we have seen so far!"

Bryant has studied birch around the world, analyzing which ones muster up the strongest defenses against browsing, and Carrière's twigs helped show one end of the range.

Carrière has welcomed the chance to be part of this larger study into the hare cycle. "Any biologist in the North is interested in this fluctuation. Otherwise it would be like studying the ocean and not being interested in salt water," she says.

"The hare population goes up because of food, and goes down because of predation, but what is less understood is why they crash every ten years," she says. "Something has to reset the cycle, and the link could be climate-related, or the climate's effect on food."

Sunspot cycles also run in ten-year cycles and biologists have theorized that increases in solar activity could drive the hare cycle. While changes in solar activity could help increase food for the hares, it could also increase the number of fires.

Browsing by hares causes birches to increase their chemical defenses.

(photo: Danny Allaire)

Carrière says that this research points out that not all birch are created alike. "The research tells you that just knowing the species of a tree in the forest is not enough; you have to know where it came from because of these special adaptations," she says.

While birch in the Canadian North and Alaska are browsed heavily every ten years during the hare cycle, this is not the case in places like Iceland and Finland which have not always had large populations of browsers. Accordingly birches there have not evolved chemical defenses against browsers.

Researchers have established that Alaska paper birch (*Betula neoalaskana*) evolved in the ice age refuge of Beringia. It is not known for sure whether snowshoe hares also originated there, and might have been browsing on birch for the last 10,000 years.

But many other browsing mammals roamed Beringia during the Pleistocene Epoch, and extinct megaherbivores such as the American mastodon might have helped to kick off the birch's chemical defense strategy. Some have speculated that the evolution of chemical defenses in plants might even have contributed to the decline of some of the Beringian megaherbivores.

Carrière notes that climate change in this era could also affect populations of

herbivores in the North. If a warmer climate leads to more severe fire seasons, causing plants to increase their chemical defenses even more, browsers could find their normal food less to their liking in the boreal forest.